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was described by M. Lorois in the "Révue et Mag. de Zoologie," in 1852, as *A. Nouryi*. Mr. Conrad, in his monograph of the genus, mentions that Capt. O. Swain, of Nantucket, in 1850, obtained a number of this species in the same vicinity. They were observed on the surface of the water on a perfectly calm day, when the sun was very hot. They appeared in large numbers, in one group at first, and then dispersed in smaller groups of twos and threes, moving with great rapidity over the surface. Approaching them with great caution, a number were secured. A year or two ago Capt. Dow, well known as an indefatigable collector, sent to the Smithsonian Institution two fine specimens captured in Lat. 10° south, Long. 90° west, almost the same spot whence they were originally obtained by M. Noury. So far as I am able to ascertain they have not been elsewhere detected. In one of them the ova, of a red color and very small, were agglutinated to the outside of the spire, as previously noted.

It is pleasant to add that our first detailed account of the Argonaut and its development, was published by a lady, Madame Power, who made her observations in the Mediterranean, having a sort of marine enclosure made, where she kept these animals and observed their habits from life.

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## ON THE PARASITIC HABITS OF CRUSTACEA.

BY A. E. VERRILL.

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THERE are few subjects pertaining to the study of animals more curious and interesting than the various phenomena connected with the parasitism of certain species upon others. This subject is also one that has many important practical bearings, since our worst crop-destroying insects are kept in check mainly by insect parasites, feeding either on the eggs, the larvæ, or the mature insect. Our domestic animals also.

and most quadrupeds, birds and fishes used as food, are afflicted, and often suffer greatly from parasitic insects, crustacea and worms; and even man himself is likewise the prey of numerous parasites, both external and internal, some of which, like the *Trichina spiralis*, often cause painful diseases and even death. But the subject has also a peculiar interest, when philosophically considered in connection with the varied phenomena of life and the theories of the origin of species. But at the present time it is our purpose merely to call attention to some curious facts concerning the habits of Crustacea, hoping that it may induce the readers of the NATURALIST to study more carefully the habits of this class, which, in this respect, is still very imperfectly known.

It is certainly singular that a very great majority of all animal parasites belong to the Articulate division of the animal kingdom, while very few are found among the Radiates, Mollusca, and Vertebrates.

The three great classes of Articulates each have numerous parasitic representatives. The external parasites of land animals are mostly Insects, and their internal parasites are Worms; but the external parasites of aquatic animals are mostly Crustacea, while their internal parasites are both Crustacea and Worms.

The class of Crustacea is naturally divided into three great groups, or subclasses. The highest, known as *Decapods*, have five pair of legs, hence their name, which signifies ten-footed. The lobsters and crabs are good examples. The next great group have seven pair of legs, or are fourteen-footed, hence their name *Tetradecapods*. The pill-bugs and sow-bugs are familiar land species. The lowest division, known as *Entomostraca*, have fewer mouth organs, and the legs are irregular in number and position, while the abdomen has no appendages and often amounts to a mere spine, as in the *Limulus*, or "Horseshoe Crab," which is a huge representative of the group, while most of the other species are quite small.

Although many of the Entomostraca, like Cyclops, Cypris, etc., are active and free swimming little creatures, which swarm in our ditches and ponds during summer, there are a great many forms that are true parasites, and infest fishes and other aquatic animals. These are mostly low and degraded species, in which the females become enormously developed, as compared with the minute males, and take on very singular shapes, losing, in many cases, by the progress of growth, all resemblance to their original form. In fact in some cases when mature they would scarcely be taken for Crustacea at all, had not their development been observed. Among these singular forms are a great number of genera which adhere to the external surface of fishes, and others to the gills and the membranes of the mouth. *Lerneæ*, and allied genera, are common upon various marine fishes. *Penella*, with its long quill-like body, lives on fishes. *Clavella*, which has also a very elongated form, lives upon the halibut; *Trebius* and *Pandarus* infest sharks, etc.; *Caligus* has numerous species which live on various marine fishes, and *Argulus* is common upon fresh-water fishes, and is also found on tadpoles. Prof. Dana, who many years ago carefully studied a species of *Caligus*\* that lives upon the cod, states that it does not suck the blood, as had been supposed, and thinks that it feeds upon the mucus, as its mouth-parts are well adapted for that purpose. But *Lerneæ*, *Penella*, and their allies, adhere only by their proboscis, which is embedded in the skin, and often barbed with hooks, and probably serves to suck the blood. Some forms of Entomostraca allied to these, are internal parasites of serpents.

A very singular genus called *Splanchnotrophus*, lives as true internal parasites in various naked marine mollusca, on the British coasts. *S. brevipes* infests *Doto coronata* and *Eolis rufibranchialis*, while *S. gracilis* is found in *Doris pilosa* and *Idalia aspera*. Since some of these mollusca inhabit also the coast of New England, we may expect to

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\* *C. Americanus* Dana. American Journal of Science, Vol. 34, p. 225.

find these or similar parasites. The male lives free in the visceral cavity, but the female is much larger and stationary, and as the ovaries develop, the clusters of eggs and tip of the abdomen project through the integuments of its victim. Another Entomostracan genus, *Doridicola*, contains small active species which are external parasites on the gills of similar mollusca.

The Tetrdecapods are not so often parasitic as the Entomostraca, yet many curious parasites of fishes, etc., belong to this division. The Isopod order, including the pill-bugs, and many aquatic species having a similar depressed form, contains more parasitic species than does the Amphipod order, which includes the compressed species.

Among the parasitic Isopods we find some curious species which live parasitically in the mouth of fishes, usually adhering firmly to the roof of the mouth by means of their numerous strong and sharp claws, and in that situation often grow so large as to almost entirely fill the mouth, causing no doubt a great amount of suffering to the helpless fish, and, perhaps, eventually its death by starvation. Such are the habits of certain species of *Livoneca* and allied genera, while other similar species live upon the exterior and in the gill-cavity, both of marine and fresh-water fishes. I have recently found an allied form in the stomach of a toad-fish from Florida, where it appeared to be truly parasitic. It was nearly an inch long and half as wide. *Nerocila*, *Anilocra*, and *Cymothoa*, are allied genera, including numerous species, all of which are parasitic on or in fishes. These genera have a more or less, oval or oblong, broad, stout, depressed body, with short crooked legs beneath, armed with sharp claws. Some of these species become three inches long and nearly an inch broad, and must be very annoying.

Another related group of Isopods includes *Bopyrus* and *Jone*, with allied genera, which are parasitic on other Crustacea. In these the males are small, and have the ordinary

Isopod form, but the female by excessive growth becomes five or six times as large, deformed in shape, and firmly adherent in the gill-cavity of its host, where it produces a deformity and enlargement of the carapax, looking like a large tumor. *Jone thoracicus* infests a species of *Calianassa*; *Bopyrus squillarum* victimizes a species of *Squilla*; and *B. Hippolites* infests various northern species of Hippolyte. It was observed last season by Mr. S. I. Smith and the author, at Eastport, Me., on *H. Sowerbyi*. Several other species are known having similar habits.

Among the Amphipods we find *Themisto* and *Hyperia*, parasitic on the large jelly-fishes of our coast, especially *Cyanea* and *Aurelia*. *Hyperia* is very common, and may be known by its large head and eyes and swollen body, which is usually of a dull reddish color. They live and breed in cavities that they themselves form in the disk of the jelly-fishes, by eating away its soft substance. They also live among the mouth-folds and ovarian lobes, often in large numbers and of all sizes; but they occasionally leave their victim for a time and swim freely in the water. Mr. Smith has reared our native species by feeding them on fragments of jelly-fishes, and ascertained that they undergo considerable changes, the antennæ becoming shorter at successive moults, showing that some of the nominal species, based on the length of these organs, are merely stages of growth of one species. Several other parasitic Amphipods were observed by Mr. Smith and the writer, at Eastport. One small species with bright golden eyes lived in the interior of *Modiolaria lævigata*. Another pretty, pale-pink, smooth, red-eyed species was found repeatedly living parasitically in the stomach of our large Red Sea-anemone (*Urticina crassicornis*), but was seldom seen until the *Urticina* had been placed in alcohol, when several would often come forth and move about for a short time, but occasionally they were observed to come forth voluntarily, and after swimming about for some time would suddenly dart

into the mouth again, as if for protection! Nor did they seem to suffer any harm when caught and held for a long time in the grasp of the large tentacles of the anemone, as often happened, but when finally released were as lively as ever, and quite as willing to voluntarily enter the mouth. And yet the tentacles of *Urticina* are covered with myriads of powerful stinging organs, by means of which it can almost instantly kill various other larger crustacea, mollusca, fishes, etc., which are also quickly digested in its capacious stomach. The immunity that this species of Amphipod enjoys is evidently similar to that of *Hyperia*, which revels among and consumes the very powerfully armed, stinging tentacles of *Cyanea*, which so quickly kill most other small marine animals, and even severely sting the human skin. A pink-colored species of *Anonyx* was observed in immense numbers upon and in a species of sponge, upon which it appears to be parasitic, at least while young. The various species of *Caprella*, remarkable for their long slender bodies and legs, and their curious looping gait, recalling the motion of Geometrid larvæ, appear to be parasitic on Hydroids and sponges. The Whale-louse (*Cyamus*) is allied to these, but has a short and broad body, with stout legs and claws, by which it clings to the skin in the manner of *Cymothoa* and other fish-lice.

The Decapod Crustacea afford, however, some still more curious instances, though they are seldom true parasites, if by this term we designate parasites that obtain their food at the expense of another by sucking its blood or absorbing its digested nutriment. But among the Decapods we find many species that are parasitic in or on other animals for the sake of shelter and protection, while in other cases there are such singular associations formed between two or more different species, that it becomes difficult to tell which is the host and which the parasite, or whether it may not be an arrangement for mutual benefit. Most persons have no doubt seen the little crab, with a smooth, rounded body,

that lives in the interior of the shell between the gills of the oyster, and is often cooked with that excellent bivalve. This is the *Pinnotheres ostreum* (Fig. 41), and is doubtless parasitic in the oyster merely for the sake of shelter, and probably does not injure the oyster unless by the irritation that its motions might cause. But it is doubtless an unwelcome guest, though the ancients had a notion that a similar species inhabiting the Pinna acted as a sort of sentinel by giving notice of danger, and thus warned the Pinna when to close. Hence its name, which signifies Pinna-guardian.

Fig. 41.



Another species, *P. maculatum*, lives in mussels (*Mytilus*) upon our coast. Another lives at Panama in a species of *Lithodomus*, a shell allied to *Mytilus*, but which is itself parasitic, and lives in holes which it excavates in other shells and corals. There are many other species of *Pinnotheres*, and allied genera, having similar habits. One fine species\* lives in the Pearl Oyster (*Margaritophora fimbriata*) of the Bay of Panama. It often shares its secure pearly retreat with a curious slender fish, and with two other genera of Crustacea, very different from itself, resembling craw-fishes or miniature lobsters in form. The most common of these is a new species of *Pontonia*,† a genus previously known to be

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\* *Pinnotheres margarita* Smith, sp. nov., female. Body covered with a very short and close pubescence, looking very much like a uniform coating of mud. Carapax quite thick and hard, considerably broader than long, and strongly convex; cardiac region protuberant and separated from the branchial and gastric regions by a deep depression, which extends along the cervical suture to the hepatic region; front strongly deflexed, and with a slight median depression. Chelipeds very stout, the fingers acuminate and curved at the tips. Ambulatory legs rather stout; dactyli in the first three pairs short, curved, and pubescent nearly to the tips, except in the right leg of the second pair, where the dactylus is very long, almost straight, and wholly naked; in the posterior pair the dactyli are long, straight, slender and pubescent. Length of carapax, 11.8 millimeters; breadth, 13.8.

† *Pontonia margarita* Smith, sp. nov. Body and all the appendages smooth and naked. Carapex very broad, depressed; rostrum short, sharp and slender at the tip; a slender spine on the anterior margin at the base of the antennæ. Eyes small, the cornea smaller than the peduncle. Flagella of the antennulæ short, the inner ones slender; the outer ones of about the same length, stout, fusiform. Anterior legs slen-



parasitic in the shell of *Tridacna*, of the East Indies, and in the large *Pinna* of South Carolina. Another genus, *Pinnixia*, allied to *Pinnotheres*, has two Carolina species. *P. cylindrica* Say, lives in the tubular burrow of a large worm, *Arenicola cristata*; the other, *P. Chaetopterana* St., lives in the strong tube of another large worm, *Chaetopterus pergamentaceus* St. Another allied form, remarkable for its nearly globose body and hairy legs, *Pinnaxodes Chilensis* Smith (*Fabia Chilensis* Dana), lives upon the coast of Peru and Chili in the shell of a small species of Sea-urchin (*Euryechinus imbecillis* Verrill), which it causes to grow out of shape. It appears to enter the anal opening when quite small, and retaining its position until fully grown, causes the intestine to dilate into a sort of cyst, and the anal area and upper part of the shell to become deformed. When fully grown it often fills nearly a third of the body of its host, and yet has but a small external orifice, out of which it probably cannot come, but the male, being much smaller, may readily enter. From the fact that nearly all the specimens of this Sea-urchin found thrown upon the beach, amounting to over one hundred, had this parasite, it is probable that it eventually weakens or kills its host by the irritation it produces.

Another very singular genus, *Harpalocarcinus marsupialis* St., lives among the branches of *Pocillipora caespitosa*, at the Hawaiian Islands, and by its constant motions while remaining in one spot causes the coral to grow up around itself so as to form as perfect and secure a residence as could be desired, while openings are left to admit water and food. I have observed similar cavities on *Pocillipora elongata*

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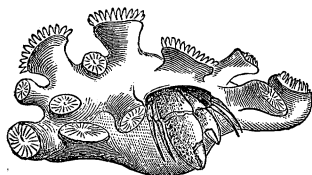
der, hands small, about half as long as the carpus; legs of the second pair stout, the hands somewhat unequal and much longer than the carapax, much swollen, fingers compressed, their inner edges sharp, the dactylus slender, and with a single tooth in the middle fitting neatly into a corresponding notch in the propodus; succeeding legs slender and cylindrical, the dactyli very short and bi-unguiculate, the terminal unguiculus strongly curved, and a shorter one very much hooked at its base. Abdomen small, the first six segments slightly exceeding in length the length of the carapax. Length of body 20 to 30 millimeters.

from Ceylon, which are probably made by another species of the same genus. The genera *Trapezia* and *Tetralia* include small, smooth and polished, usually bright-colored crabs, which live free among the branches of *Pocillipora* and *Madrepora*. For this mode of life they are well adapted, both by their smooth, flat bodies, and by their peculiar feet, which are blunt at the end and furnished with sharp stiff spines to aid them in climbing among the coral branches. *Domecia hispida* has the same habits.

The Hermit or Soldier Crabs, are interesting in their habits, and well known to all sea-side naturalists. They always occupy the dead shell of some spiral Gasteropod, which they carry about on their backs, and into which they retreat when alarmed, holding it firmly by means of the long, spirally-curved abdomen, and by its hook-like appendages. But some species are apparently not satisfied with even this protection, and consequently induce certain species of Sea-anemones to dwell upon the shell they inhabit. The beautiful Sea-anemones belonging to the genera, *Adamsia* and *Calliactis*, are rarely found except in this situation. *Adamsia maculata*, of the European coast, attaches itself to the shell occupied by *Eupagurus Prideauxii*, near the inner lip, and spreads out its base laterally on each side until the lobes thus formed meet around the aperture and coalesce so as to form a complete ring, through which the crab emerges and retreats. The base of this *Adamsia* also has the unusual power of secreting a thin but firm pellicle, by which it extends the edges of the aperture of the shell, thus giving the crab more room, as it grows larger, and obviating the necessity of changing the shell, as other less-favored hermits are obliged to do. Several specimens of *Calliactis* usually occupy the same shell, and are not known to be capable of extending its aperture. All the species are very beautifully colored, and inhabit tropical seas. In the West Indies *C. bicolor* and *C. tricolor* are common, and one species occurs at Florida, while *C. variegata* occurs at Panama. *Cereus sol*

has the same habit, and occurs on the Carolina coasts. On our own shores the shells occupied by Hermit Crabs are usually completely covered by a beautiful little pinkish Hydroid (*Hydractinia polyclina* Agassiz), which at times extends the lip of the shell by its basal expansions. A still more curious instance of this kind is afforded by the *Gemma*

Fig. 42.



*maria Americana* Verrill\* (Fig. 42), a Zoanthoid polyp, allied to the Sea-anemones, but capable of budding from basal expansions, by which means it completely covers shells occupied by *Eupa-*

*gurus pubescens*. After thus covering the shell, it is not only capable of extending the aperture by its own growth, but has the power of entirely dissolving and absorbing the substance of the shell so that no trace of it can be found, though the form is perfectly preserved by the somewhat rigid membrane of the polyp. This species has been found in deep water, off the coast of New Jersey, and in Massachusetts Bay.

Another still more remarkable case occurs in the China Sea. A Hermit Crab (*Diogenes Edwardsii* St.) found there has upon the outside of the large claw a circular, smooth space, upon which there is always found a small Sea-anemone (*Sagartia Paguri* Verrill). This appears to be an association for life, since very young crabs carry a very minute *Sagartia*, no larger than a pin's head, and large crabs have a large *Sargartia*. In this case when the crab retreats into its shell and folds down the large claw over the aperture, the *Sargartia* would appear to be attached within the aperture, and thus conceal and perhaps protect the crab. In all these and other similar cases, the advantage of association is doubtless mutual, for while the Sea-anemones, by means of their outspread tentacles, armed with stinging organs, of which fishes and other voracious animals have a wholesome

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\* Memoirs of the Boston Society of Natural History, Vol. i, pages 34 and 45.

dread, serve to protect the crab, the latter can more effectually travel about and seek food, and while tearing its prey into small pieces, many choice bits doubtless fall to the lot of its companion.

There is another group allied to the Hermits, the species of which often carry a valve of some bivalve shell upon the back for protection. At Florida and in the West Indies, *Hypoconcha arcuata* St., is found carrying a valve of Venus, or some similar shell, while at Panama *H. Panamensis* Smith\* carries a valve of *Pecten ventricosus*, holding it on by means of the two posterior pair of legs, which are bent up over the back, aided by the posterior part of the body, which fits into the cavity below the hinge. An allied genus contains a species found from Florida to Brazil, *Dromidia Antillensis*, which carries upon its back, according to Dr. Stimpson, either a compound Ascidian or a Zoanthoid Polyp, but all the specimens in the Museum of Yale College carry a peculiar fleshy sponge, which fits upon and entirely covers the back, but is held in position by the four posterior legs. A peculiar genus of crabs, Dorippe, found on the coast of China, though not very nearly related to the two preceding, agrees with them in having the carapax broad and depressed, and in having the two posterior pairs of legs twisted up over the back, as if to hold on a bivalve shell, which may be their usual habit; but one of the species, *D. facchino*, was dredged at Hong Kong, carrying upon its back a beautiful Sea-anemone, *Cancrisocia expansa* St.,† which completely covers the back of the crab, and, like *Adamsia*, secretes from its base a thin, firm pellicle, to which it adheres, and by which the crab holds it in position with his four posterior

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\* *Hypoconcha Panamensis* Smith, sp. nov. Allied to *H. arcuata* Stimp. The carapax however, is narrower, the length equalling the breadth; the anterior margin not so regularly arcuate, and its edge broken by a marked median incision, and by distinct notches at the insertion of the antennæ; the projection in the anterior part of the lateral margin much less abrupt and less prominent; the lower surface of the facial region sparsely granulated, the granules separated by smooth spaces; terminal segment of the male abdomen smooth. Length of carapax in a male, 17.5 millimeters; breadth 17.3.

† This species, as it appears expanded upon the back of the crab, has been figured in the Proceedings of the Essex Institute, Vol. vi.

legs. It appears that when very young the crab holds over its back a minute bit of shell or gravel upon which the Anemone lodges, and afterwards, by expanding its basal pellicle as the crab grows, provides it with a permanent protection. This Anemone was never found except upon the crab's back, and the crab was not found without it. A very different crab found at Panama, *Hepatella amica* Smith,\* carries upon its back *Sagartia carcinophila* Verrill, but in this case the connection is probably less intimate, and not so permanent.

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## THE HALIOTIS, OR PEARLY EAR-SHELL.

BY ROBERT E. C. STEARNS.

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THERE is a family of Mollusca whose beautiful shells are frequently seen ornamenting the parlor mantel or centre table, the admiration of all on account of the brilliant colors and iridescence of their pearly interiors.

These shells are popularly called Sea-ears, but the scientific name is *Haliotis*, from the Greek *halios*, marine, and *otis*, ear. In the different countries where these shells are found, there are local names by which they are known. In California the people call them *Abalones*, while they are called "*Meerohren* by the Germans, *Telinga maloli* or *Bia sacatsjo* by the Malays, and *Hovileij* by the Amboynese," according to Adanson. "The Eolians gave it the pretty name of Venus's Ear. It is the 'Mother-of-pearl,' or 'Nor-

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\* *Hepatella amica* Smith, gen. et., sp. nov. The genus *Hepatella* differs from *Hepatus* in having the carapax rectangular in outline, in the much larger facial region, the very small eyes and very short eye peduncles, and in wanting wholly the depression below the orbit; the carapax is also much thicker, and the lateral regions are concave above. In this species the gastric and posterior branchial regions are protuberant and granulous, as is also the middle of the cardiac region, the rest of the carapax smooth; the lateral margins nearly parallel posteriorly but rounded anteriorly, the edge thin and armed with about twelve irregular and sharp teeth; ambulatory legs very short and crested; the sternum deeply punctate and vermiculated, and the male abdomen very narrow, acutely pointed, and five jointed. Length of carapax, 11.5 millimetres; breadth 15.8.